SWISS GEODESY AND THE UNITED STATES COAST SURVEY[1]

By Professor FLORIAN CAJORI
UNIVERSITY OF CALIFORNIA

THE influence of the intellect transcends mountains and leaps across oceans. At the time when George Washington warned his fellow countrymen against entangling political alliances with European countries, there was started a movement of far reaching scientific importance in a small country in the heart of the Alps which (as we shall see) exerted a silent, yet potent scientific influence upon the young republic on the eastern shores of North America. Our government executives can restrict the movements of troops and can abstain from making hazardous treaties, but these policies can not permanently check the subtler movements of intellectual thought which often, like aerial waves, encircle the world.

In 1785 a gifted and enthusiastic young German named Johann Georg Tralles became professor of mathematics and physics at Berne in Switzerland. Interested in applied as well as pure mathematics, Tralles was active as a metrologist and geodesist. Maps of that part of Switzerland had been altogether unreliable. He entered upon refined surveys of the triangulation type. In this work he was assisted by one of his pupils, Ferdinand Rudolf Hassler of Aarau, a young man who belonged to a well-to-do family. His father had mapped out for him a bureaucratic career which would have brought a good competence. But the mathematics and the surveying instruments of Tralles exerted an attraction impossible for him to resist. In 1791 Tralles and Hassler measured a base-line together, using a steel-chain manufactured by the English mechanic Ramsden. The base line was 40,000 feet long; its ends were marked on blocks of stone four feet high, with steel points held in position by cast lead. Not satisfied with the accuracy reached, a few years later they remeasured this base with improved apparatus. Carefully standardized rods now took the place of chains. A net of triangles was adopted, the principal points of which were the several summits of the Jura mountain range. For the great distances between stations the instruments were found to be inadequate. Tralles wrote to a friend about his angular measure-

[1] Sigma Xi address delivered at Northwestern University on December 13, 1920.

ments: "I have tortured them out with a theodolite—measurement I can not call this, when the telescope is so weak that one can not see the signals, but only guess their position. You can readily see that they are not small, for the telescope of the theodolite reveals them at a distance of 100,000 feet." The government of the Canton of Berne was appealed to for financial aid in the purchase of a more powerful instrument. Six hundred dollars were voted immediately. Mr. Ramsden in London, then the most celebrated instrument-maker living, for a sum somewhat exceeding this amount, promised to supply in 1794 a complete azimuth circle, at least three feet in diameter. Due to various delays the great instrument did not reach Berne until 1797. Meanwhile some smaller instruments had been secured from England; Tralles and Hassler had been active in perfecting their technique. Young Hassler received the commission to determine the boundary line between the Cantons Berne and Solothurn. Ramsden's three-foot theodolite was a wonderful instrument; only two other instruments of that size and precision are said to have been manufactured by Ramsden. What a privilege for young Hassler to become practically acquainted with the use of an instrument of the high type that very few surveyors then living had ever seen!

Hassler repeatedly took trips to Paris and one trip to Germany; he attended lectures and became personally acquainted with leading scientists—among them Lalande, Borda, Delambre and Lavoisier in Paris; Von Zach and Bohnenberger in Germany. With funds liberally supplied by his father, Hassler purchased many instruments and scientific books. He astonished Von Zach late one afternoon by measuring with a five-inch English reflecting sextant and mercury horizon the latitude of Zach's observatory and differing only five seconds from previously known determinations. We see Hassler occupied with serious studies and becoming familiar with the practical operation of the most refined mathematical instruments in existance at the time.

Geodetic work in Switzerland was stopped by revolutionary events. In 1798 French soldiers marched into Berne. Friction arose between Franch and Swiss goedesists. A few years passed without bringing relief. Hassler who meanwhile had married and had held various official positions of responsibility in his canton of Aargau became weary of European turmoil, and decided to seek his fortune in the New World. Strange to say we find him engaged in the organization of a stock company for the purchase of large tracts of land in South Carolina. In 1805 he departed with wife, children, servants and 96 trunks, boxes and bales, and travelled down the Rhine, having previously chartered in Amsterdam the ship "Liberty" (350 tons) for Philadelphia. He was accompanied on his trip by over 100 laborers to form a Swiss colony in the South. Unfortunately Hassler's agent speculated with

the funds entrusted to him and Hassler sustained heavy financial loss. He arrived in Philadelphia without means to support his family. While waiting for remittances from his father, he sold some of his books and instruments. He received financial assistance also from John Vaughan, a prosperous and public spirited Philadelphian.

Hassler soon got in touch with scientific men in Philadelphia. He attended meetings of the American Philosophical Society. On December 6th, 1805, he donated to this Society a model of Mont Blanc, two chamois horns, and a specimen of feldspar. Hassler was elected a member of the Society on April 17th, 1807. The year previous he had sold to the Philosophical Society "the volumes necessary to complete the transactions of the French Academy of Science of which the Society possessed eighty-nine volumes, the bequest of Dr. Franklin." Hassler sold also some volumes of the transactions of the Berlin Academy. I mention these items to indicate the kind of books Hassler brought to America.

He brought also a number of instruments and standard weights and measures, such as had never before been carried to the American shores. Among these were a standard meter, made at Paris in 1799 by the Committee of Weights and Measures, a standard kilogram, an iron toise, made by Cavinet in Paris, two toises of Lalande. All of these were acquired by the American Philosophical Society and were loaned to Hassler twenty-six years later when he was acting in Washington as superintendent of weights and measures.

In 1806, Professor Robert Patterson and John Vaughan in Philadelphia, John Garnett of New Brunswick and others were deeply impressed by the ability and enthusiasm for science displayed by Hassler. Patterson was then director of the United States Mint. Feeling no doubt that the services of this talented young man of 36, whose long course of special training secured in Switzerland, France and Germany, made him one of the very foremost living practical geodesists, should be enlisted by the American Government, Professor Patterson gave President Jefferson an account of Hassler's life. "He would willingly engage," said Patterson, "in an exploring expedition, such as those you have already set on foot."

As neither Patterson's letter to President Jefferson, nor Hassler's brief autobiography enclosed with it, has ever appeared in print, it may be interesting to present these documents, at least in part.[2] Professor Patterson wrote:

[2] For copies of these documents, and of the letters written by President Jefferson and President Madison which we quote later, we are indebted to the kindness of Dr. Anita Newcomb McGee of Washington, D. C. The originals are in the Manuscript Division of the Library of Congress. Dr. McGee is a great granddaughter of Hassler.

(From Robert Patterson, Director of the Mint, to Jefferson.)

Philad. March 3d 1806.

"Sir

"I beg leave to introduce to your notice Mr. Hassler, a gentleman lately from Switzerland. He is a man of science & education; and, as will appear from the enclosed paper, written by himself at my request, was a character of considerable importance in his own country. It is his wish to obtain some employment from the United States, which would require the practice of surveying or astronomy. He would willingly engage in an exploring expedition, such as those you have already set on foot; for which, I have no doubt, he would be found well qualified.

"In his education he paid perticular attention to the study of astronomy, and statistical surveying; & from the enclosed paper you will see, that he is well versed in the practice. He is a man of a sound, hardy constitution, about 35 years of age, & of the most amiable conciliating manners. Besides his knowledge of the Latin language, he speaks the German, French, Italian & English. To his acquaintance with mathematics in general, which, as far as I am capable of judging from a short though not slight acquaintance, is very extensive, he adds a good knowledge of chemistry, mineralogy, and all the other branches of natural philosophy. In short, Sir, I believe his services may be rendered useful to this his adopted country. He possesses a very valuable library, and a set of surveying & astronomical instruments, scarce inferior to any I ever saw.

"I shall only add, that the cause for which he struggled in his native country, and the reasons for his seeking an asilum here, will not, Sir, I am sure, detract from his merit in your estimation.

"I have the honour to be,
"with sentiments of the
"greatest esteem,—
"Your most obedient servt.
R. Patterson.

"P. S. I forgot to mention, that Mr Hassler is at present settled with his family (a wife & three children with a few domestics) on a small farm near the banks of the Schuylkill, and that he proposes very shortly to pay a visit to the seat of government."

Hassler's sketch of his life which was enclosed in the letter that Patterson sent to President Jefferson, is reproduced here with all its orthographic peculiarities:

"Feb. 27, 1806.

"After my first education in public and private schools at Arau, my native town, I went in my 16th Year 1787 as a Voluntary in an

office of the government of Berne, appointed for all kind of surveyings and the care of the archives of the state, in which businesses I worked; following at the same time the lessons of the College, then newly established under the name of political institute, and the private instructions of Mr. Tralles Professor of Mathematics, (now member of the Academy of Berlin) aplying chiefly to practical geometry & astronomy. As a practical exercise of these instructions Mr Tralles & I undertoock in 1791. (on my expenses) the trigonometrical mesurements for a map of the country, and mesured a base of 7¾ Miles length and some triangles, with proper means and instruments, till the season interrupted the further prosecution.

"The Government of Berne, seeing the various advantages of this Work, undertook to follow it, and appointed proper funds for the instruments; which were comitted to Mr Ramsden in London.

"In 1792 I went to the university of Göttinguen, (staying a short time in my passage at the Observatory of Mr de Zach at Seeberg) where I continued my studies in mathematics and natural Philosophy, under Kästner and Lichtenberg; (with whom I was particularly acquainted): Obliged nevertheless by the wishes of my father, to give some time to the study of Diplomatics under Gatterer.

In 1796, I went to Paris applying half a Year chiefly to Mineralogy & Chymistry under Haüy, Vauquelin, Fourcroy &c. (being already acquainted by a former Voyage there with LaLande & Borda.)

In 1797. a large Theodalite of Ramsden beeing arrived at Berne Mr Tralles & I endeavoured to prosecute now for the Government the Geographical Operations begun in 1791. but ware soon stoped again by the Revolution of Switzerland early in 1798. which event changed at the same time my position by annulating a post of my father the succession of which was secured to me since my 16th Year.

Though the ministry of Finances of the Helvetic Republic, desireous of an accurate mape of the country gived me on a new the commission to follow the Work and I worked at it a short time in 2 Seasons the perpetual changes & finally extinction of the unitary Government put an end to this Work for which I could neither get my advances repayed nor my Labour. On my leaving the Country I left the unfinished Work to one of my friends to be sold for a trifle to the new Government.

Though I took no trouble to get any public office I was early in 1798. elected to the Court of appeal of the Canton of Argovia for the direction of criminal affairs, (accusateur public) from which place I was called in 1799. by the Central Government to the same functions at the Supreme Court of the Helvetic Republic, after the extinction of which in 1803, I went at home were I was elected by the representatives of the Canton a member supleant of the Court of Appeals, and by my

fellow-Citizens a member of the Counsel of the town, in which I was trusted with the chief Direction of public buildings and Archives.
But foreseeing the constant oscillations in the state of the Country involving always my position according to past experiences (intrigues and ambition, which are wanted in such circumstances, beeing out of my Caracter) I took with seme of my friends the resolution to come over to America in search of more solidity in a peaceable Country.
Though I shall be one of the Directors of a Society of my countrymens intending to come over in this Country my presence beeing not always nor absolutely wanted, I could and wished to be employed in some business where practical Geometry & Astronomy would be the requisites, by preference.
Philadelphia 27th Febr: 1806: F:R:Hassler."

In addition to Professor Patterson's letter and enclosure, President Jefferson received a letter from Dr. C. Wistar of Philadelphia, recommending Hassler. President Jefferson's reply to Dr. Wistar, which has never been printed, is as follows:

"Yours of the 19th, [February 19th 1807] has been received, as was a former one proposing Mr. Hassler to be employed in the survey of the coast. I have heard so much good of him as to feel a real wish that he may find the employment of the nature to which his physical constitution & habits may be equal. I doubt if. in yielding this as to Mr. Hassler, I transgress a principle I have considered as important in making appointments. The foreigners who come to reside in this country, bring with them an almost universal expectation of office. I recieve more applications from them than would fill all the offices of the U. S. * * * It is true there are some employments * * * into which meritorious foreigners & of peculiar qualifications may sometimes be introduced. such is the present case."

It appears that the starting of the survey of the coast of the United States was taken under consideration by members of the American Philosophical Society at Philadelphia for the reason that there had come into their midst a man preeminently qualified to undertake such a survey. In other words, had Hassler not come to the United States, probably no effort would have been made at that time to organize such a survey. Upon President Jefferson's recommendation, Congress passed a law, authorizing a survey on February 10th, 1807, and made an appropriation of $50,000. Albert Gallatin, Secretary of the Treasury, addressed a circular letter to scientific men, asking for plans for carrying the survey into effect. Among the replies were letters from Robert Patterson of the U. S. Mint, James Madison, then President of William and Mary College, Andrew Ellicott who had long been active as a surveyor in the United States, John Garnett of New Brunswick who

was interested in astronomic and geodetic affairs. Hassler's reply was written in the French language; it carefully outlined a trigonometric survey and the use of chronometers in localities where trigonometric surveys would be very difficult. At President Jefferson's direction, a commission passed upon these plans. That Hassler's plans would be chosen seemed to be a foregone conclusion in the minds of most scientists interested. The commission was formed of the very men who had submitted plans, with the omission of Hassler, who was then at West Point. In rejection of their own plans, they recommended Hassler's. On account of political disturbances in Europe and America the survey was not begun in 1807. Meanwhile Hassler had been appointed acting professor of mathematics at West Point, where he served two years. Later he was for one year professor at Union College at Schenectady.

During his residence at West Point and Schenectady he had occasional correspondence with Patterson regarding details for the coast survey, especially the necessary instruments. On September 2, 1807, Patterson asked him by letter whether he would be willing to go to London to direct the construction of the instruments there. Hassler expressed his willingness to undertake the mission, but not until August, 1811, was the government able to send him. Hassler embarked with his large family for England.

After the death of Ramsden, Edward Troughton came into ascendency as a skilled mechanic. It was his ambition in life to surpass Ramsden as an instrument maker. Hassler set Troughton and others to work, manufacturing under his direction instruments for the United States Coast Survey. Some of the principal instruments were of Hassler's own design. He secured instruments and books also from Paris. Politically the time was unfavorable; the war of 1812 broke out. Hassler was in the country of the enemy. Once he was refused a passport in London until after a personal application was made to the foreign secretary, who granted the passport with the generous remark "that the British Government made no wars on science."

The total amount expended for instruments during four years in England and France was $37,500; including books, Hassler's salary and travelling expenses, the outlay exceeded $55,000. Troughton, the celebrated London instrument maker, remarked that there was not so complete and useful a collection of instruments in the possession of any government in Europe.

On October 16, 1815, Hassler informed Mr. Dallas, then Secretary of the Treasury, of his safe arrival with the instruments, in Delaware Bay; they were deposited at the University of Pennsylvania. Some of the instruments were intended for use in two astronomical observatories that were to be established according to Hassler's plans which

had been matured some time in the interval 1807-1811. He brought back all the instruments then deemed essential for the astronomical observatories except a mural circle and zenith sector, which he "did not venture to order, as their absolute necessity, in connection with the survey of the coast, was not so obvious as that of the instruments procured."

"To procure the greatest advantage to the survey," continued Hassler, "their positions [positions of the observatories] should be as far North East and South West as the very favorable position of the United States admits"—one in the district of Maine, the other in Lower Louisiana. "Nearly every celestial phenomenon observable from the tropic to the arctic circle and within about two hundred degrees of difference of longitude, could be observed at one or the other of them." Little did Hassler realize at that time that over a quarter of a century would elapse before Congress would authorize a national astronomical observatory.

Not until May 2, 1816, did Congress pass appropriations for the survey of the coast. In August of the same year Hassler was appointed Superintendent of the Survey of the Coast. In his eagerness to begin work Hassler had gone to Long Island and reconnoitered the neighborhood during the month before his regular appointment. At first he had only three inexperienced cadets from West Point to help him; in September, Major Abert, one of his West Point acquaintances, was detailed to assist him. Great difficulty was experienced in finding a satisfactory locality for the measurement of a base line. Bad weather caused further delays. Once his work was interrupted by a law-suit brought by a man who charged that Hassler had cut off some branches of a cedar bush, to make the remaining part of the bush answer as a temporary signal. There were no railroads in those days; public highways were few. Hassler's work took him to localities not easily reached. For conveying of himself, his men and his delicate instruments, he had constructed early in 1817 a spring carriage, of special design, to be pulled by two or four horses. This carriage became famous because of its odd appearance and because political opponents of Hassler charged that he indulged in luxurious travel, such as was enjoyed by no other government official.

Delays occurred also because of tardiness on the part of the Government in sending the necessary funds. At times Hassler advanced money of his own, to prevent interruption of the work. The difficulties experienced from wooded marshes and the absence of sharp points near the coast made it necessary for him to plan for a full chain of triangles back from the shore. The proper locality for a base was not found until April, 1817. In February the Secretary of the Treasury asked Hassler to state the probable time required for the execution of the

survey. This was a disquieting question; as yet, the survey had hardly begun! In the Canton of Berne, Switzerland, four years had been considered none too long a period for a much smaller project. With Major Abert as his only trained assistant, Hassler worked during 1817 from the opening of the season in April until the end of December, when none but Hassler "thought it possible to stand it any longer" on account of the cold. He worked early and late, whenever weather permitted, and displayed an enthusiasm seldom equalled. At that time Hassler knew little about American politics. He proceeded on the supposition that if he maintained high scientific standards, if he worked hard and faithfully, his services would be appreciated. He learned by sad experience that this is not necessarily the case, that the head of a government scientific bureau must take pains to keep in touch with political leaders and through personal contact and courtesies extended must endeavor to secure the interest and good will of these leaders; in other words, that political leaders must be educated to the appreciation of science. Hassler did not work in Washington at that time. In winter, when work in the field was impossible, he resided in Newark, New Jersey. Even if he had tried, it would have been difficult to have kept in touch with Congressmen.

In 1817 eight triangles were formed, determining the distances of about forty points with great accuracy; two bases were measured; latitudes and azimuths were ascertained. After December, the winter was passed in performing the necessary computations. On April 6, 1818, the Secretary of the Treasury apprised Hassler of the fact that the little progress made in the survey had caused general dissatisfaction in Congress. This was a bolt from an almost clear sky. Hassler replied by telling what had been accomplished—more than double what had been achieved in the English survey in the same time. After sending this reply, Hassler, who was in Newark, concluded that he had better go to Washington with all his documents, so that he could offer any explanation desired. His explanations to the Secretary of the Treasury were of no avail; on April 14, 1818, the law authorizing the survey was so modified by Congress as to exclude Hassler, a civilian, and leave the survey in charge of military and naval officers.

The fundamental difference between Hassler and Congress was that Hassler aimed to make a triangulation survey that would be a credit to America in the eyes of scientific men of the world; such a survey requires time. Congress, on the other hand, had no intention of aiding science; they wanted a map of the coast and that without delay.

Terrific as this blow must have been to Hassler, he took it calmly. Defeats never subdued him; they spurred him on to renewed efforts. Krusenstern wrote him from St. Petersburg, "In Russia your talents would have been better appreciated."

For fourteen years nothing creditable was done on the coast survey. No one connected with it had the training, experience and vision to carry it on successfully. These years constitute the dark ages of the United States Coast Survey.

For Hassler these fourteen years from the age of 48 to 62 should have been scientifically the most productive years of his life; but eleven of the fourteen were the most barren. We pass in silence his years of struggle to support his large family, years during which the operation of a farm in northern New York proved financially disastrous, years during part of which his energy was dissipated by school teaching in small private academies and in the compilation of elementary text-books; years of mental anguish over the breaking of family ties. I may add parenthetically that Hassler had nine children, several of whom died in childhood. Hassler's eldest son has many descendants in this country. Hassler's son, Charles Augustus, was a surgeon in the U. S. Navy and was the father of Mary Caroline, wife of the late Simon Newcomb, the astronomer. Mrs. Newcomb is now living in Washington.

In 1830 Hassler was placed at the head of the work of weights and measures—a scientific department of the Federal Government organized by him. His ten years of preparation in Switzerland and his trips to France and Germany fitted him admirably for such work. Finally in 1832, when Hassler was 62 years old, Congress experienced a lucid interval and re-enacted the law of 1807 on the Coast Survey. Hassler was reinstated as superintendent. For eleven years he labored assiduously, until death claimed him. During that time the Coast Survey advanced with rapid strides, notwithstanding continual interference by government officials and members of Congress.

Hassler remained mentally alert to the very last. He kept in touch with geodesists and astronomers of Europe. He was in correspondence with Gauss of Göttingen. He was in touch with Bessel who wrote a critical yet very appreciative review of Hassler's description of his plans and instruments for the U. S. Coast Survey, printed in 1825. Bessel saw in those plans original features which placed them higher than any plans then in operation in other countries. Hassler was in regular correspondence with Schumacher, the editor of *Astronomische Nachrichten;* with Admiral Krusenstern and the elder Struve in Russia; Hassler communicated with the astronomer Tiarks and with Edward Troughton in England; occasionally he contributed papers to European journals. He was an associate of the London Royal Astronomical Society. In our country he kept in correspondence with Thomas Jefferson and James Madison. Thus, instead of living a submissive, passive life, instead of vegetating, he kept his mind alert, young and creative.

The reader may be interested in an unpublished letter which ex-

President Madison wrote Hassler on February 22, 1832, when Madison was in his eighty-first year:

Montpelier, february 22, 1832.

Dear Sir:

I have received your favor with the accompanying copies of your report on weights and measures. I have forwarded the two, one for Professor Patterson and one for the University of Virginia, and shall dispose of the others as you desire. For the copy allotted to myself, I return you my thanks. The decrepit state of my health, added to my great age and other causes, have prevented me from looking much into the work. My confidence in your aptitude for it, takes the place of a positive proof of its merits.

I am glad to learn that you are to resume the important labor of surveying the coast. I hope you will be able to complete it; and to your own satisfaction, in which case I doubt not it will be to the satisfaction of those who invite you to the undertaking.

I tender you sir my esteemed friendly salutations.

(Signed) James Madison.

The creative side of Hassler is seen mainly in the design of new instruments. He put forth an improved repeating theodolite. For signals at geodetic stations, Hassler, in 1806, recommended spherical reflectors, such as he had used in Switzerland, but later introduced truncated cones of tin which could be manufactured easily and cheaply and under ordinary and easy conditions, possessed advantages over the heliotrope invented later by Gauss. Hassler appears to be the earliest geodesist who thought of using the bright reflection of solar light from a gilt ball or cone. After 1836 Hassler used Gauss' heliotrope for great distances to be pierced under bad atmospheric conditions. Most original was Hassler's base line apparatus which involved an idea worked out by him in Switzerland and perfected in this country. Instead of bringing different bars in actual contact during the progress of base-measurements, he used only one bar and *optical* contact. Each end of the bar was marked by a spider web; a compound microscope standing upon a separate support was placed at the forward end, right over the spider-web. As the place of this end of the bar was determined by the microscope the bar could be moved forward and its back end placed under the microscope. This was truly an ingenious procedure.

It is interesting that Hassler's plans for an observatory in the United States which were presented to the Government in 1816 and published in 1825 should resemble those actually carried out later by Schumacher in the Altona Observatory in 1826. From obvious principles both scientists deduced independently of one another, plans closely resembling each other.

In the making of maps, Hassler used what is now called the American polyconic projection. This projection was well adapted for the eastern coast of the United States which is a narrow strip extending ap-

proximately north and south. Mr. C. H. Deetz of the Coast and Geodetic Survey, says that "Hassler's polyconic projection possesses great popularity on account of mechanical ease of construction and the fact that a general table for its use has been calculated for the whole spheroid." "It has," adds Mr. O. S. Adams, "been extensively used by the United States Coast and Geodetic Survey."

When Hassler resumed work on the Coast Survey in 1832 his health was somewhat broken, but his mind was clear and his spirit unbroken and defiant of his opponents, to the very last. "Difficulties have never subdued me in my life," "I have worked in sick days and in well days" are statements the more impressive, when we recall his struggles against poverty, the large family dependent upon him, the illness of his children, his serious family vicissitudes, the advantages taken of him by supposedly personal friends, the limitations placed upon him by government red tape, and the political attacks hurled against him. In these respects his career resembles that of the immortal Kepler.

In his struggles with government officials, Hassler insisted that for the greatest success of the Coast Survey, the Superintendent must be given liberty to hire men whenever the work required it, to arrange for transportation of instruments by land or water, the purchase of instruments and books within the limits set by the appropriations made by Congress. This liberty, said Hassler, the Superintendent of the Coast Survey should have, just as a sea-captain is allowed "to set the sails of his vessel according to the wind and sea." Hassler's signing the list of accounts with the statement "these expenses were incurred in consequence of my direction for the survey of the coast" were objected to by auditors of the treasury department as insufficient. Hassler entered a vigorous protest and in this struggle won out on many points.

A bone of contention was Hassler's salary. An anecdote became current about 1836 that Secretary Woodburry and Hassler could not agree on this point, and that Hassler was referred to President Jackson. "So Mr. Hassler, it appears the Secretary and you cannot agree about this matter," remarked President Jackson, when Hassler had stated his case in his usual emphatic style. "No sir, we can't". "Well, how much do you really think you ought to have?" "Six thousand dollars, Sir." "Why, Mr. Hassler, that is as much as Mr. Woodbury himself receives." "Mr. Voodburry!" declared Hassler, rising from his chair, "there are plenty of Voodburrys, plenty of Everybodys who can be made Secretary of the Treasury. But," said he, pointing his forefinger toward himself, "there is only one, *one* Hassler for the head of the Coast Survey." President Jackson, sympathizing with a character having some traits in common with his own, granted Hassler's demand.

One objection raised to Hassler in Congress was that his survey was too slow and expensive; a modified, less scientific, more expedi-

tious plan was advocated. As we look back now after the passage of four score years, Hassler stands out greatest in perceiving and singling out what was best in the practical goedesy of his time, in making improvements upon what he found, and then clinging to his plan, which was a triangulation scheme, as being the best that the science of his day brought forth—clinging as a mother does to her child in danger. What looms highest is his moral quality and strength to resist compromises, to resist hazardous alterations suggested by engineers and statesmen, to maintain this opposition against the adoption of "cheaper" yet "just as good" plans, and to persist in this opposition year after year, decade after decade, from young manhood to old age. The services of Hassler to the Nation loom larger and larger with the lapse of time. Hassler scorned pretensions and shams. Says a recent writer: "Due to his far sightedness the best foundation was thus laid for geodetic operations."

Switzerland, at the close of the eighteenth century, embodied in its triangulation surveys the best that European science could offer. Tralles and Hassler introduced some novelties of their own. The Swiss science and art of geodesy were carried by Hassler to the United States. Keeping in constant touch with European progress, Hassler exercised his genius in adopting European practice to American conditions and adding improvements of his own. Thus, Switzerland became the mother of American Geodesy.